NMFS ALBACORE TUNA FORECAST & RESEARCH PLANS FOR 1972

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Based on environmental conditions and the trend in the historical record of commercial albacore catch distribution, fishery scientists at the NMFS La Jolla Laboratory predict that the major portion of the albacore catch during the 1972 season will be taken in waters south of San Francisco. It is estimated that 70 to 80% of the total catch will be south of San Francisco, with most of it off central California. Therefore, only 20 to 30% of the total catch is expected to be made north of San Francisco, which is below the long-term average of 36%. Between 30 and 45 million pounds will be caught by commercial boats south of San Francisco; between 10 to 15 million pounds north of the city. However, these estimates of albacore landings could be low if many more boats enter the commercial albacore fishery.

Sports boats operating in southern California waters should have very good albacore fishing this season. However, warm-water conditions could develop in southern California waters in late summer and limit fishing success.

NMFS' 12TH Annual Prediction

This is the 12th annual fishery prediction by NMFS (formerly Bureau of Commercial Fisheries) for the albacore tuna fishery off the North American Pacific coast. The prediction of the general distribution of the albacore fishery is based partly on an experimental index developed at the NMFS La Jolla Laboratory. This relates the north-south distribution of the fishery with environmental conditions during the spring months in certain offshore waters. The method is based partially on the assumption that mid-ocean environmental conditions encountered by incoming migrants affect the distribution of the fish when they enter North American waters.

In past years, the prediction was based solely on sea-surface temperature conditions observed in spring in the near-shore waters where the summer albacore fishery traditionally takes place. The earlier method was based on the assumption that trends in environmental conditions observed in spring persist and indicate the probable distribution of sea-surface temperature in mid-summer. However, experience has shown that dynamic air-sea interaction processes during summer can alter considerably temperature conditions observed during the spring period prior to the fishing season.

The estimates of tonnages expected to be landed during the 1972 albacore fishing season are based on statistical calculations with historical data. Current population dynamics research underway at the NMFS La Jolla Laboratory and elsewhere should enable us in the near future to make more accurate forecasts of tonnage and general size of the fish that will enter the fishery.

AVERAGE SEA-SURFACE TEMPERATURE

The 12-year average (1960-71) of optimum temperature zone for albacore in the July 1-15 period is shown in shaded portion of Plate 1. The majority of albacore caught in North American waters are taken in waters of this temperature range. Prevailing weather during this period in 1972 will likely cause deviations from this average pattern, which will influence the distribution of albacore. We will monitor the evolving temperature patterns in order to project the albacore distribution as the season develops.

RECENT TRENDS IN OCEANIC & ATMOSPHERIC CONDITIONS

During the last 2 weeks of May, sea-surface temperatures along the North American coast were slightly below the long-term mean from northern Washington to Point Conception and out to 130° W. Colder temperatures about 2° F below the long-term mean occurred offshore Vancouver Island,

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and in localized coastal areas off Cape Blanco and between Point Arena and Monterey. Sea-surface temperatures were slightly above the long-term mean south of Point Conception to central Baja California and out to 125° W--except for a region along the coast and south of Ensenada, where temperatures were below the long-term mean. The 60° F isotherm was near its normal position, except between about 125° and 130° W, where it was displaced to the south (Plate 2).

During the winter of 1971-72, thermal conditions in the eastern North Pacific were characterized by a "warm pool" of above-normal temperatures over a large central region between latitudes 25° and 50° N and to the west of longitude 140° W; below-normal temperatures prevailed in a broad zone extending southward from Gulf of Alaska along North American coast and westward towards Hawaii south of 25° N. These conditions resulted in a strong east-to-west thermal gradient and were indicative of increased flow in the California Current system.

Strong Thermal Contrast Dissipates

In March 1972, this strong thermal contrast began to dissipate, with the "warm pool" shifting eastward and southward. It diminished further during April 1972 as warm temperatures in the central oceanic regions and cool temperatures along the coast edged closer to normal values. By the end of May 1972, remnants of the above- and below-normal temperature regions were present but greatly reduced in size and intensity from the previous winter.

The evolution of these changes in the large-scale thermal conditions of the eastern North Pacific can be linked to abnormal circulation patterns in the overlying atmosphere throughout winter 1971-72 and spring 1972. During late winter and spring, the erosion of the large pool of warm water resulted from stronger-than-normal north to northwesterly winds. These transported cooler water into the area and caused above-normal heat loss from the ocean through increased evaporation. In addition, the strong north-northwesterly winds that occurred in offshore coastal regions throughout the winter abated, and colder-than-average water in the areas returned to more normal values.

According to the Extended Forecast Division of the National Weather Service, northerly winds offshore of southern Oregon and California are expected to be stronger-than-normal during June 1972. The above-normal north-northwesterly winds should retard seasonal warming of surface waters through increased upwelling, evaporative cooling, and southerly transport of water from the north. These effects could result in cooler-than-normal surface temperatures along the coast and upwelling could favor local biological enrichment for production of adequate tuna forage.

HISTORICAL TRENDS IN CATCHES

Plate 3 is a bar graph showing total landings of albacore tuna for the Pacific west coast (U.S. and Canada) for 1938-71. The graph does not take into account changes in fishing effort and efficiency or availability. West-coast landings for the 1971 season, based on preliminary information, were 53.4 million pounds. These were slightly lower than the 1970 total of 57.5 million pounds and higher than the 1962-71 average of 50.0 million pounds. Although exact data are not available, rough weather during parts of the 1971 season and unavailability of fish near the season's normal end tended to limit fishing activity and success for individual boats. The 1971 season was shorter than in 1970. According to the Western Fishboat Owners Association, more vessels fished for albacore in 1971 than in recent years. Thus, although 1971 west-coast landings were down only slightly from 1970, catches by many individual fishermen were markedly lower. A further increase in fishing effort is expected this year because many boats are planning to enter the fishery.

The percentage of the west-coast catch north of San Francisco in 1938-71 is shown in Plate 4. The percentage north-south distribution of the catch reflects the large shifts in location of the centers of the albacore fishery over the last three decades. It appears that the fishery is shifting back to southern waters after being centered in northern waters in recent years. The fishery swung northward in 1965 and reached its peak in 1968 and 1969, when 85% of the catch was north of San Francisco, mostly off Oregon and Washington. Last year, about 36% of the west-coast catch, which is near the long-term average, was north of San Francisco.

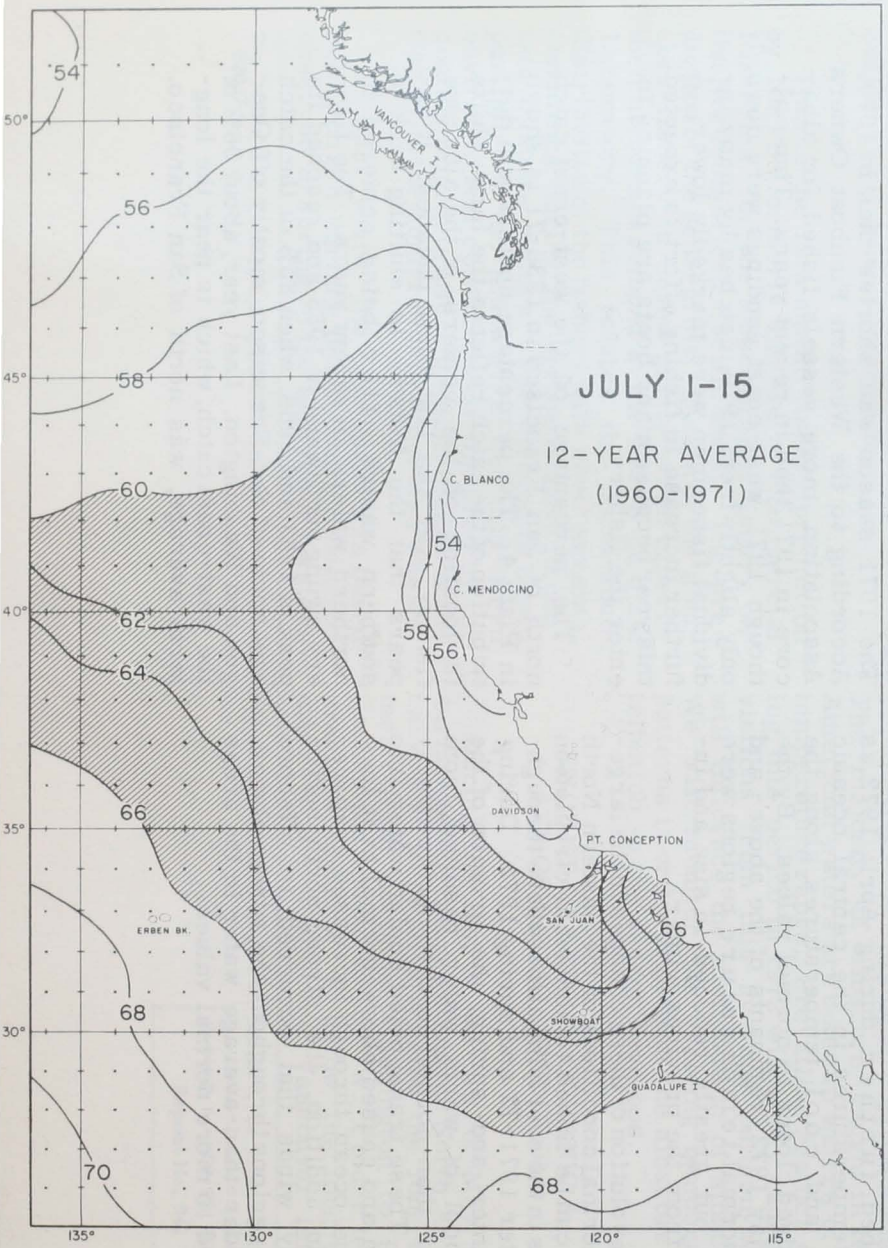


Plate 1.--Average sea surface temperature fields for the July 1-15 interval. Shaded zone delineates region where most of the albacore would be available under these conditions.

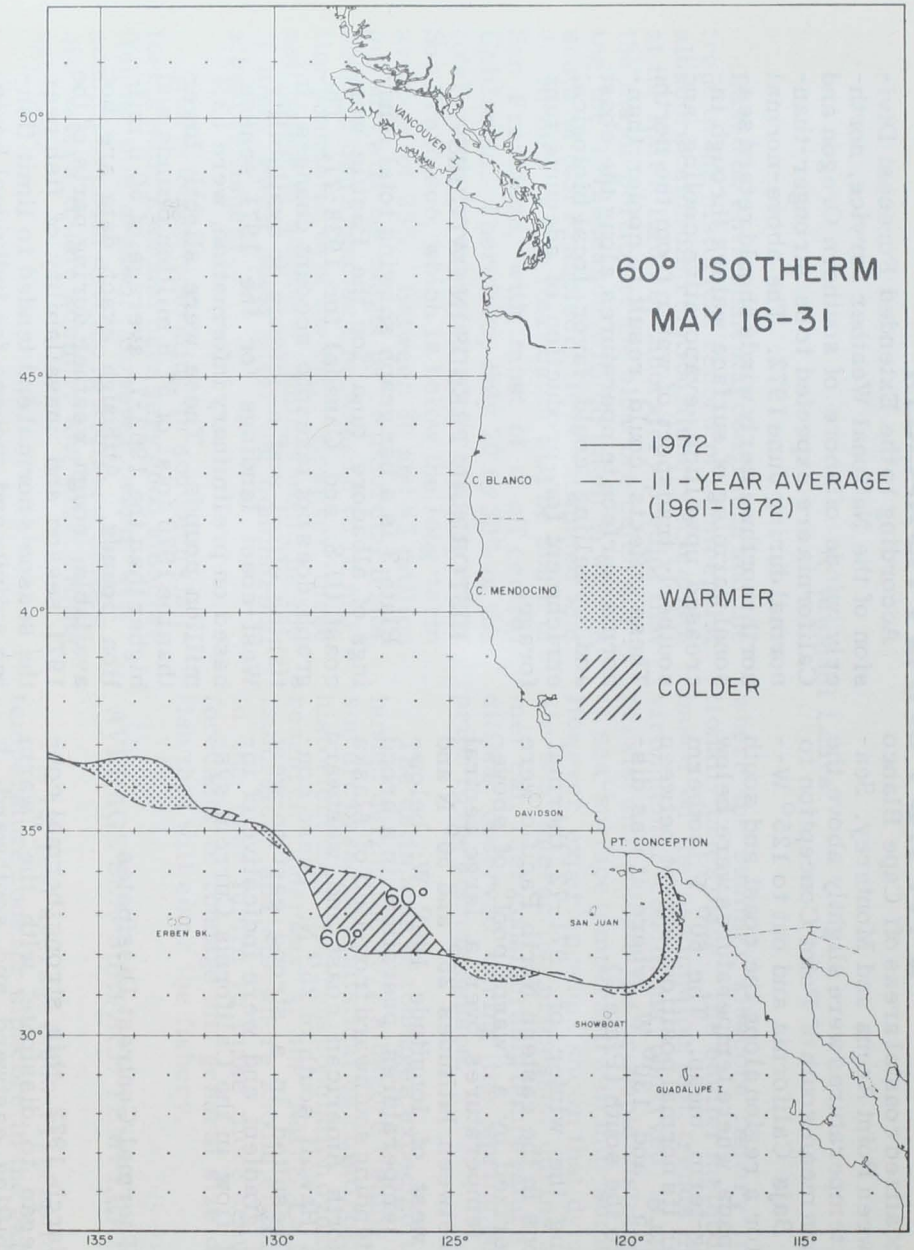
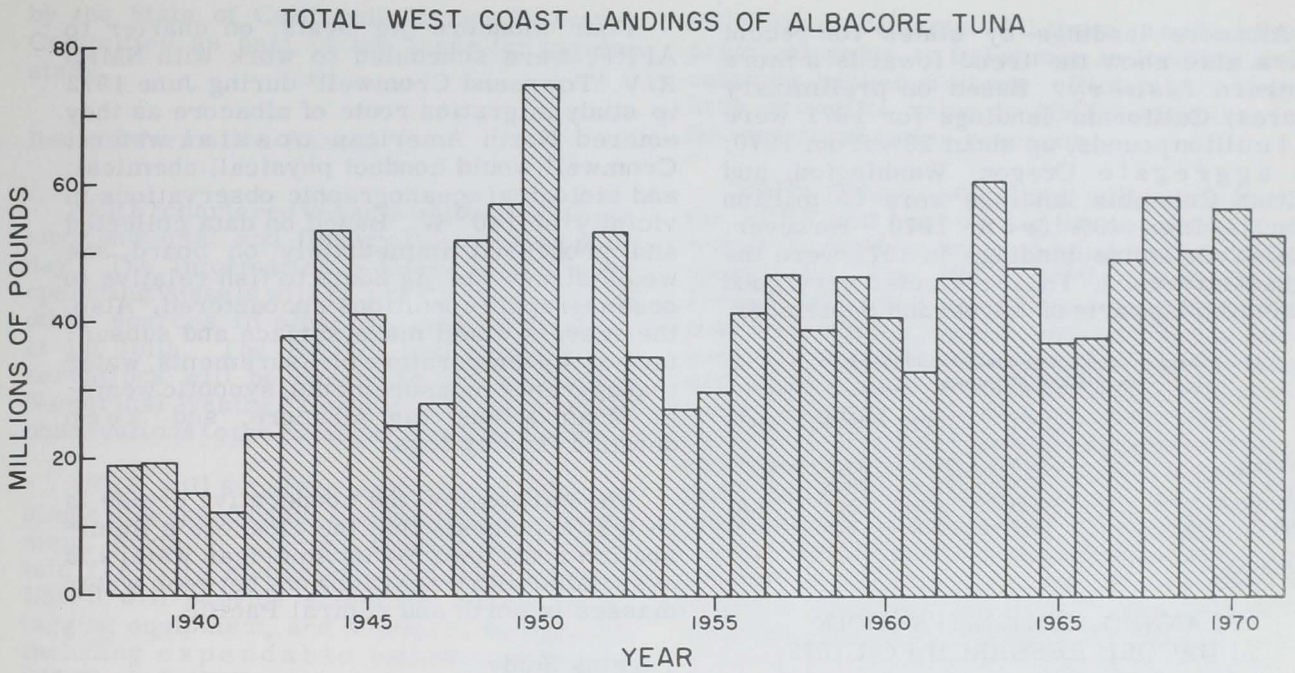


Plate 2.--Relation of position of May 16-31, 1972, 60°F. limiting isotherm to long-term average position for the same interval.



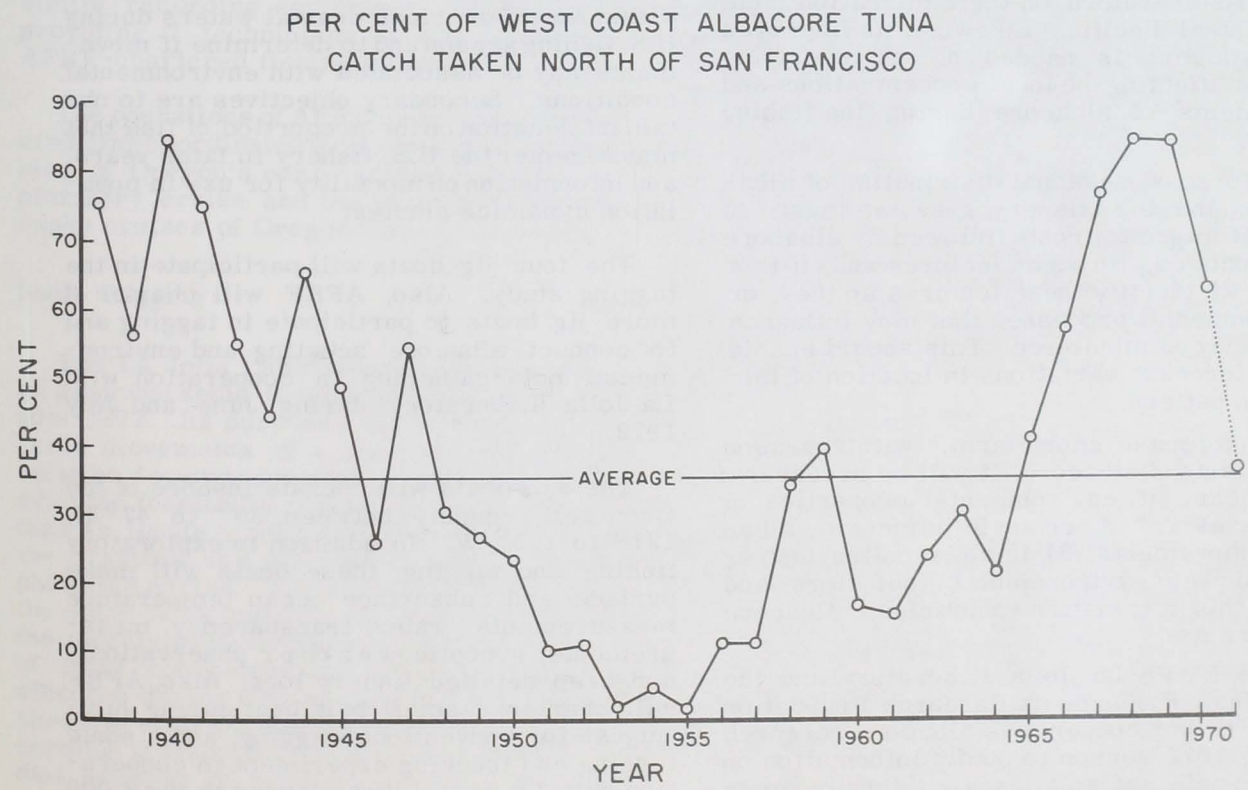


Plate 3. --Top graph: Total west coast landings of albacore tuna in millions of pounds, 1938-1971.

Plate 4. --Bottom graph: Percent of west coast albacore tuna catch taken north of San Francisco, 1938-1971.

Albacore landings by states for recent years also show the trend towards a more southern fishery. Based on preliminary figures, California landings for 1971 were 38.4 million pounds, up about 28% from 1970; the aggregate Oregon, Washington, and British Columbia landings were 15 million pounds, down 46% from 1970. However, British Columbia landings in 1971 were the highest on record. These reflected very good fishing during parts of August and September.

Albacore Landings by State for 1968-71
(in millions of pounds)

	1971*	1970	1969	1968
California	38.4	29.9	14.7	15.1
Oregon	8.4	21.8	29.8	37.8
Washington	2.9	4.3	3.5	3.0
British Columbia	3.7	1.6	2.5	2.6

*Preliminary.

PLANNED JOINT NMFS-AFRF ALBACORE RESEARCH FOR 1972

To expand the U.S. albacore fishery earlier in the season, a better understanding is needed of where albacore enter North American coastal waters on their migration from the central Pacific. Likewise, an improved understanding is needed of the underlying factors affecting the local concentrations and movements of albacore during the fishing season.

To forecast seasonal distribution of albacore in the U.S. fishery area, we must: 1) learn if migration route followed by albacore is associated with ocean features and, if this is so, 2) identify these features so they, or environmental processes that may influence them, may be monitored. This should enable us to forecast variations in location of migration pattern.

To forecast short-term, within-season movements of albacore, it will be necessary: 1) to learn if environmental properties or processes are important in influencing albacore movements; 2) if so, monitor and/or predict key environmental indicators, and 3) use this information to anticipate albacore movements.

The NMFS La Jolla Laboratory and the American Fishermens Research Foundation (AFRF) plan cooperative albacore research during 1972 season to obtain information on large-scale and small-scale migratory patterns of albacore.

Four albacore jig boats, on charter to AFRF, were scheduled to work with NMFS R/V 'Townsend Cromwell' during June 1972 to study migration route of albacore as they entered North American coastal waters. Cromwell would conduct physical, chemical, and biological oceanographic observations in vicinity of 140° W. Based on data collected and processed immediately on board, she would direct the jig boats to fish relative to oceanographic conditions encountered. Also, the vessels would make surface and subsurface ocean temperature measurements, water transparency measurements, synoptic weather observations, tag albacore, and keep detailed fishery logs.

The purpose of the cooperative cruise is to test hypothesis that the albacore's immigration route into North American waters is associated with transition zone between water masses in north and central Pacific.

Tagging Study

The La Jolla Laboratory is also directing an albacore-tagging study. It is designed primarily to examine movements of albacore within North American coastal waters during U.S. fishing season and to determine if movements may be associated with environmental conditions. Secondary objectives are to obtain information on the proportion of fish that may re-enter the U.S. fishery in later years, and information on mortality for use in population dynamics studies.

The four jig boats will participate in the tagging study. Also, AFRF will charter 8 more jig boats to participate in tagging and to conduct albacore scouting and environmental data-gathering in cooperation with La Jolla Laboratory during June and July 1972.

The 8 jig boats will operate inshore of the Cromwell, roughly between 30° to 47° N, 127° to 135° W. In addition to exploratory fishing and tagging, these boats will make surface and subsurface ocean temperature measurements, water transparency measurements, synoptic weather observations, and keep detailed fishery logs. Also, AFRF will charter a small bait boat during July-August for conventional tagging, and a sonic tagging and tracking experiment in cooperation with La Jolla. It is planned to tag 4,000 to 5,000 albacore. NMFS was granted $10,000

by the State of California Marine Research Committee as part of the funds for tagging study.

Radio Information Ashore

AFRF-chartered vessels will radio ashore environmental and fishery information each day. The information received from the cooperating vessels will be used with that from other sources in albacore-tuna forecasting at La Jolla. The BATHY and weather observations will be passed to the Navy Fleet Numerical Weather Central, and the weather observations to the National Weather Service.

AFRF will supply to each chartered boat single side-band radio communication equipment, portable live-bait holding tanks, certain fishing equipment, and wind gauges. NMFS will provide scientific advice, fish-tagging equipment, and scientific equipment, including expendable bathythermographs (XBT) and XBT probes (supplied by Navy Fleet Numerical Weather Central, Monterey, California), thermograph (one boat), bucket thermometers, secchi disks, and radio facsimile recording equipment. NMFS is also providing 7 technicians to tag aboard the AFRF-chartered fishing vessels.

The operations of AFRF-chartered vessels are being coordinated with the Fish Commission of Oregon's early-season albacore exploratory cruise and the albacore-oceanography cruises of Oregon State University.

Sonic Tagging

The La Jolla Laboratory plans to conduct an albacore sonic-tagging experiment in August 1972. Its purposes are to study small-scale movements of albacore schools in relation to environmental conditions; and to evaluate feasibility of fishermen using sonic tags to locate a school(s) of albacore fished the previous day but lost during nighttime, shutdown period. The scientific objective of the study is to improve our understanding of the underlying factors affecting the prediction of local concentrations and movements of albacore during fishing season. The results should provide considerable information concerning movements of albacore schools on diel patterns of movement, rates of movement, how much time a school spends at the surface, and environmental factors that may influence movements. All these results have practical value to fishermen in locating and catching albacore more efficiently. They have scientific value to NMFS scientists in fishery-forecasting research.

NMFS fishery scientists will work from the AFRF bait boat during the second half of August to conduct sonic tagging and tracking operations. The NMFS R/V 'David Starr Jordan' will conduct albacore-oceanography research during August and coordinate her work with sonic-tagging experiments. Jordan will make a suite of environmental observations including subsurface temperature, salinity, and other hydrographic measurements, and monitor continuously surface temperature, salinity, and chlorophyll. Numerous observations will be made to evaluate biological factors of the environment, including primary productivity, zooplankton standing stock; a specially developed sampler will measure the small-scale distribution and relative abundance of potential albacore forage organisms.

Also, it is planned to use a light aircraft equipped with an airborne radiation thermometer to obtain a synoptic evaluation of the small-scale features and changes in the distribution of sea-surface temperature where the sonic tagging is conducted. The McDonnell-Douglas Astronautics Company is also participating in the experiment making overflights with an aircraft equipped with a multispectral scanner for measurement of ocean color and other data. The environmental data gathered by Jordan and the planes will be used to determine if environmental conditions influence or control small-scale movements of albacore, as indicated by sonic tracking.

NMFS ADVISORY OPERATIONS FOR 1972 SEASON

The La Jolla Laboratory will issue albacore advisory information throughout the 1972 season in addition to the seasonal forecast. The advisory information will include sea-surface temperature charts, narrative albacore fish bulletins, and daily broadcasts of albacore fishing information over marine radio bands.

La Jolla issues the publication 'Fishing Information' monthly. It contains charts of sea-surface temperature for the North

Pacific and eastern tropical Pacific, sections of subsurface temperature structure for parts of the North Pacific, charts of winds and pressures for the eastern North Pacific, a narrative description of pertinent temperature conditions, and fishery advisory information.

The albacore fish bulletins will be issued twice each month from June 15 until the season ends, in conjunction with 15-day sea-surface temperature charts. The 15-day sea-surface temperature charts, now issued year round, cover the area roughly between central Baja California and Vancouver Island out to 135° W. The bulletins will include short-term projections of albacore distribution and locations of productive fishing areas, information on oceanographic and atmospheric conditions, and other information. The NMFS fishery advisory materials are mailed to fishermen upon request and are bulk-mailed to fish buyers and processors for further dissemination to fishermen.

Daily Broadcasts

Again this year, daily broadcasts of albacore fishing information will be prepared by La Jolla and transmitted over marine radio bands. The broadcasts were scheduled to be made twice daily on weekdays, and once on Saturday mornings, from June 12 through October 31, or until the albacore season ends. The broadcasts will include the latest albacore fishing information obtained from research vessels, cooperating fishing vessels, and unloading station operators. Highlights will include location of active centers of fishing, typical fishing scores, size of fish, sea-surface temperature and subsurface temperature information when available, and other information. Sport-boat activity will be included.

A weather and sea-state summary tailored to fishermen's needs and prepared by the National Weather Service will be given. It will include large-scale weather features and long-range outlook, regional wind, weather, and sea-state conditions for offshore waters, and storm development. In addition, for each 15-day period, the broadcast will include map coordinates for the 15-day average position of the 60° and 64° F isotherms for the region east of 130° W longitude and between 25° and 50° N latitude. The broadcasts will be made on weekdays and Saturday mornings by the following radio stations:

WWD (La Jolla, California) on AM compatible frequency 4409.4 and on SSB carrier frequencies 4409.4, 8644.1, 8789.6, and 13147.5 kHz at 0600 and 1945 PDT.

KMX (Astoria Marine Operator) on 2598 kHz at 0630 and 1945 PDT.

KRED (Eureka, California) on commercial AM 1480 kHz at 0600 and 2000 PDT.

The success of the albacore advisory program depends on the input of timely, first-hand information from fishermen at sea and dock operators and processors. Fishermen are encouraged to report oceanographic, weather, and fishing information. As a channel of communication for such information, radio station WWD will operate the following voice single side-band frequencies and schedules:

Carrier frequencies	
WWD transmit	WWD receive
4409.4	4410.8
8789.6	8255.6
13147.5	12368.5

Hours of operation are 0400-0100 local time, 7 days per week, including holidays. Information may also be radioed to the Western Fishboat Owners Association. The NMFS La Jolla Laboratory will accept collect calls from fishermen at sea to report oceanographic, weather, and fishing information.